# Glass Transition of ABS in 3D Printing

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## Abstract

In a commercial 3D printer head, plastic ribbon passes through a hot nozzle of an extruder to dispense liquid plastic droplets to construct the model. In this paper a 2D axisymmetric model of a 3D head is considered to study the secondary transition change from below the glass temperature to above the glass-transition temperature of ABS (Acrylonitrile Butadiene Styrene) using COMSOL Multiphysics® Software. To achieve accurate results, the melt flow fields in combination with the heat transfer and change in tensile modulus are considered. The model includes the secondary transition, both in terms of latent heat and in terms of other thermodynamic and physical variables. The simulation is based on the assumption that there is no volume change during solidification of ABS. It is also assumed that the velocity of the melted ABS is constant and uniform throughout the modeling domain. The transition from the glassy to the molten state of ABS is modeled using the heat capacity model. A narrow secondary transition is observed during the glass-transition temperature.

## Reference

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# Figures used in the abstract

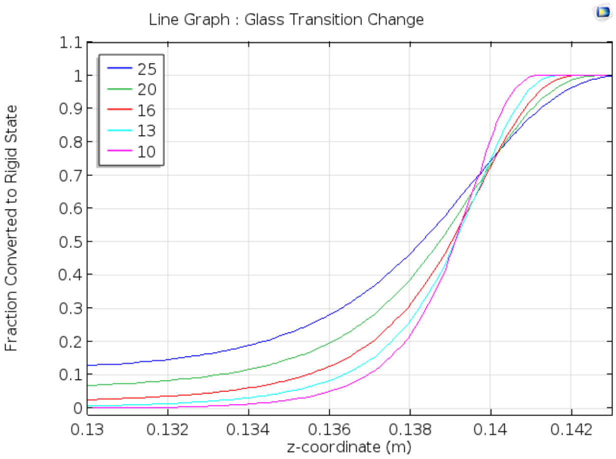


**Figure 1:** The fraction of liquid rubbery state along the centerline for all values of temperature change. For smaller values of temperature change the glass transition is steeper.

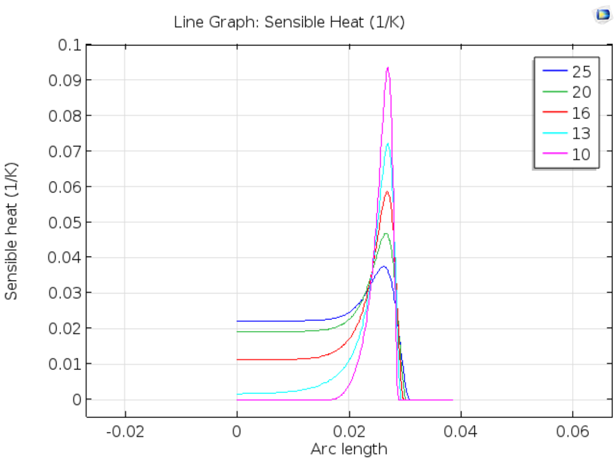


**Figure 2:** As the temperature change gets smaller, particularly 10 K, the curve is not entirely smooth. As a result, to model with reduced increments for temperature change, one must to increase the mesh resolution.